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NATIONAL DAM SAFETY PROGRAM. JONES LAKE DAM (MO 31486), WHITE R--ETC(U)
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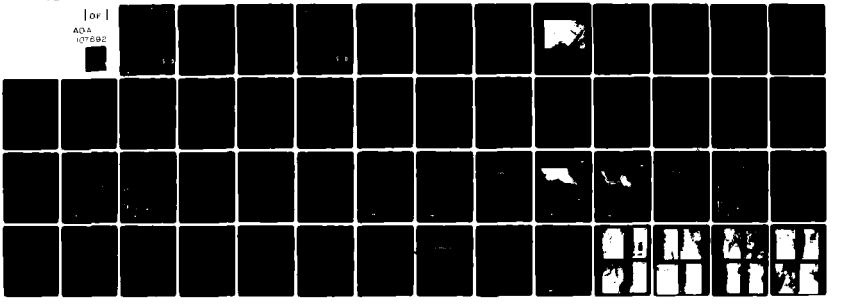

LEVEL II

1

WHITE RIVER BASIN

AD A107692

JONES LAKE DAM

OREGON COUNTY, MISSOURI

MO 31486

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

AUGUST, 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A107 692	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Jones, S. Lake Dam (MO 31486) Oregon County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Anderson Engineering, Inc.		8. CONTRACT OR GRANT NUMBER(s) DACW43-80-C-0073
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		12. REPORT DATE August 1980
		13. NUMBER OF PAGES Approximately 50
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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☆ U.S. G.P.O. 1980-665-141/1299

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: S. Jones Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the S. Jones Lake Dam (MO 31486).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 20 OCT 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 6 OCT 1980
Date

S. JONES LAKE DAM

OREGON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31486

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

AUGUST 1980

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam:	S. Jones Lake Dam
State Located:	Missouri
County Located:	Oregon
Stream:	Unnamed Tributary of Diles Creek
Date of Inspection:	June 18, 1980

S. Jones Lake Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately one mile downstream of the dam. Located within this zone are three dwellings and one trailer. The existence of these dwellings was verified during the field inspection. The dam is in the small size classification, since the maximum storage capacity is greater than 50 acre-ft but less than 1,000 acre-ft.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass 17 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood (PMF) is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the small height of the dam and the low storage capacity of the reservoir, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year flood (1 percent probability flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being equaled or exceeded in any given year.

The dam appeared to be in fair condition. Deficiencies visually observed by the inspection team were: (1) severe undermining of the concrete spillway slab; (2) some erosion of the spillway discharge channel; (3) erosion and sloughing of the upstream embankment face due to lack of wave protection; (4) some brush, small trees, and animal burrows on the upstream embankment face; (5) considerable brush and some small trees on the downstream face of the dam; (6) seepage area along lower portion of the downstream face near the toe; and (7) considerable soil and wood debris in the spillway approach channel. Another deficiency was the lack of seepage and stability analysis records.

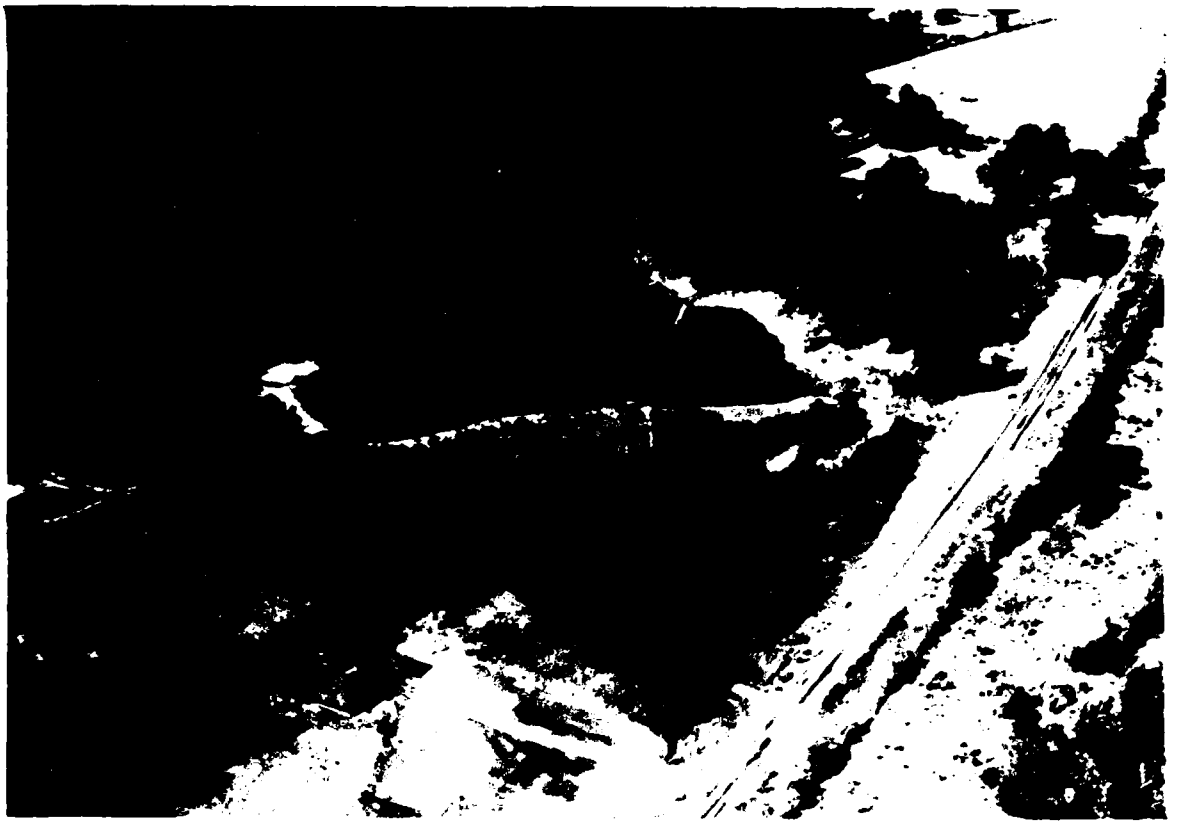
It is recommended that the owners take the necessary action promptly to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Steve Brady, P.E. (AEI)

Tom Beckley, P.E. (AEI)

Gene Wertepny, P.E. (HEI)

Dave Daniels, P.E. (HEI)



AERIAL VIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of S. Jones Lake Dam in Oregon County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

S. Jones Lake Dam is an earth fill structure approximately 21 ft high and 400 ft long at the crest. In this report, right and left orientation is based on looking in the downstream direction. The appurtenant works consist of an earth swale spillway with concrete slab at the crest located at the left abutment. Sheet 3 of Appendix A shows a plan, profile, and typical section of the embankment. Sheet 4 of Appendix A shows a profile and section of the spillway.

B. Location:

The dam is located in the southeastern part of Oregon County, Missouri, on an unnamed tributary of Diles Creek. The dam and lake are within the Couch, Missouri, 15 minute quadrangle sheet (Section 5, T21N, R3W - latitude 36° 30.4'; longitude 91° 19.5'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 21 ft and a maximum storage capacity of approximately 65 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately one mile downstream of the dam. Located within this zone are three dwellings and one trailer. The existence of these dwellings was verified during the field inspection.

E. Ownership:

The dam is owned by Mr. Sidney W. Jones. The owner's address is Route 1, Box 98, Thayer, Missouri 65791 (Telephone: 417-938-4305).

F. Purpose of Dam:

The dam was constructed primarily for recreational purposes.

G. Design and Construction History:

No design information is available. The dam was constructed in 1970 by Phil Ramas (address unknown). The owner reported that the pond downstream of the dam was there before the dam was built. The dam was built on a curve (concave upstream). A cutoff trench about 9 ft deep was incorporated beneath the dam. The owner reported that a core section was constructed in the center of the embankment. This core is about 40 ft wide at the base, and is composed of a mixture of clay and gravel. The owner said that the core was built by placing a thin layer of gravel over a layer of clay and then mixing and compacting the materials in place. Less select material was used on either side of the core. Materials for construction of the dam were obtained from the right abutment hillside and from the lake area.

The spillway was originally lined with a thin layer of concrete which extended from about 40 ft upstream of the spillway crest to about 100 ft downstream of the crest. The owner reported that this concrete lining has deteriorated significantly in the past several years.

H. Normal Operating Procedures:

The normal flows are discharged through an uncontrolled, concrete-lined earth swale spillway located at the left abutment. Information from the owner indicates that the dam has never overtopped. The spillway reportedly operates several times a year with the maximum observed water level being about 1 ft below the top of the dam.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile, and typical section of the embankment. Sheet 4 of Appendix A shows a profile and section of the spillway.

A. Drainage Area:

The drainage area for this dam, as obtained from the USGS quad sheet, is approximately 150 acres.

B. Discharge at Dam Site:

(1) All discharge at the dam site is through an uncontrolled spillway.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 774.8): 300 cfs

(3) Estimated Capacity of Primary Spillway: 300 cfs

(4) Estimated Experienced Maximum Flood at Dam Site: (Elev. 773.8) 120 cfs

(5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(7) Gated Spillway Capacity at Pool Elevation: Not Applicable

(8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level (MSL) elevation of 755.0 ft for the top of the southeast wingwall of the 3 ft by 8 ft culvert on County Highway V downstream of the dam (estimated from quadrangle map).

(1) Top of Dam: 774.8 ft, MSL (Low Point), 776.4 ft, MSL (High Point).

(2) Principal Spillway Crest: 772.0 ft, MSL

(3) Emergency Spillway Crest: None

(4) Principal Outlet Pipe Invert: None

(5) Streambed at Centerline of Dam: 755.0 ft, MSL

(6) Pool on Date of Inspection: 772.6 ft, MSL

(7) Apparent High Water Mark: None Apparent

(8) Maximum Tailwater: Unknown

(9) Upstream Portal Invert Diversion Tunnel: Not Applicable

(10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Top of Dam: 950 ft

(2) At Principal Spillway Crest: 800 ft

(3) At Emergency Spillway Crest: Not Applicable

E. Storage Capacities:

(1) At Principal Spillway Crest: 47 acre-ft

(2) At Top of Dam: 65 acre-ft

(3) At Emergency Spillway Crest: Not Applicable

F. Reservoir Surface Areas:

(1) At Principal Spillway Crest: 5 acres

(2) At Top of Dam: 8 acres

(3) At Emergency Spillway Crest: Not Applicable

G. Dam:

(1) Type: Earth

(2) Length at Crest: 400 ft

(3) Height: 21 ft

(4) Crest Width: 17 ft

(5) Side Slopes: Upstream 2.8H:1.0V; Downstream 2.7H:1.0V (from crest to water's edge)

(6) Zoning: Central Clay Core with Unselect Material on Each Side

(7) Impervious Core: Central Clay Core 40 ft Wide at the Base (information from owner)

(8) Cutoff: Key Trench 9 ft Deep (information from owner)

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: Not Applicable

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

(1) Location: Left Abutment

(2) Type: Concrete-lined Earth Swale

I.2 Emergency Spillway:

(1) Location: Not Applicable

(2) Type: Not Applicable

J. Regulating Outlets:

There are no regulating outlets associated with this dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No engineering data exist for this dam. To our knowledge, no construction inspection records or documented maintenance and operation data exist.

A. Surveys:

No information regarding pre-construction surveys was able to be obtained. Sheet 3 of Appendix A presents a plan, profile, and cross section of the dam from survey data obtained during the site inspection. Sheet 4 of Appendix A presents a profile and section of the spillway. The top of the southeast wingwall of the 3 ft by 8 ft culvert on County Highway V downstream of the dam was used as a reference point to determine all other elevations. It is estimated that this site datum approximately corresponds to mean sea level (MSL) elevation 755.

B. Geology and Subsurface Materials:

The site is located at the southern edge of the Ozarks geologic region of Missouri. The Ozarks are characterized topographically by hills, plateaus, and deep valleys. The most common bedrock types are dolomite, sandstone, and chert. The "Geologic Map of Missouri" indicates that the bedrock in the site area consists primarily of the Jefferson City Dolomite of the Canadian Series of the Ordovician System. The Jefferson City formation is composed principally of light brown to brown, medium to finely crystalline dolomite and argillaceous dolomite. The average thickness of the Jefferson City formation is 200 ft.

The publication, "Caves of Missouri," indicates that nine caves are known to exist in Oregon County, all of which are located more than 15 miles north and west of the site.

The soils in the area of the dam are of the Clarksville-Fullerton-Talbott soil association. These soils have developed from cherty limestone and dolomite, and have moderate permeability.

C. Foundation and Embankment Design:

No foundation and embankment design information was available. Seepage and stability analyses apparently were not performed as required in the guidelines. Except for the reported central core of select clay material, there is apparently no particular zoning of the embankment, and no internal drainage features are known to exist. No construction inspection test results have been obtained.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design computations for this dam were available. Based on a field check of spillway dimensions, embankment elevations, and a check of the drainage area on USGS quad sheets, hydrologic analyses using U.S. Army Corps of Engineers guidelines were performed and appear in Appendix C, Sheets 1 to 9.

E. Structure:

There are no structures associated with this dam.

2.2 CONSTRUCTION:

No construction inspection data were available.

2.3 OPERATION:

Normal flows are passed by an uncontrolled, concrete-lined earth cut spillway located in the left abutment. No operating facilities exist.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on June 18, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri, and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steve Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulic Engineer)
Dave Daniels - Hanson Engineers, Inc. (Geotechnical Engineer)

The owner did not accompany the inspection team at the site. Photographs of the dam, appurtenant structures, reservoir, and downstream features are presented in Appendix D.

B. Dam:

The dam appeared to be in fair condition. No evidence of overtopping of the embankment was observed. The upstream embankment face contains some brush and small trees. In addition, considerable erosion, sloughing, and animal burrows (see Photo No. 5) were noted on the upstream face (especially at the left portion of the embankment). The erosion channels were approximately 1 ft to 2 ft wide and up to 1 ft deep. Considerable brush and tree growth was present on the downstream embankment face (see Photos 7 and 9). Seepage areas were observed all along the lower portion of the downstream embankment face, near the toe (see Photo No. 10). These areas were wet and soft, but no measurable flows or transportation of soil particles were observed.

The vertical alignment of the crest seemed good. The dam was built on a curve (concave upstream), and no surface cracking or unusual movement was obvious. The presence of a pond at the downstream toe precluded inspecting this area for stability and additional seepage problems. The owner reported that the pond was there before the dam was built. Sheet 5 of Appendix A presents a plan sketch of the dam showing observed features.

Shallow auger probes into the embankment indicated the dam to consist of reddish brown cherty clayey silt to silty clay (ML-CL). The owner indicated that material for construction of the dam was obtained from the lake area and from the right abutment hillside.

C. Appurtenant Structures:

C.1 Primary Spillway:

The approach to the spillway contained silt and considerable wood debris, temporarily raising the pool elevation above the concrete slab level by about 0.6 ft (see Photos 11 and 12). It appeared that the silt resulted from the activity of burrowing animals near the spillway. The overtopping analysis was performed assuming that this soil and debris is washed away by flood flows (using the elevation of the concrete slab as normal pool).

Information from the owner indicates that the spillway was originally lined with concrete from about 40 ft upstream of the crest to about 100 ft downstream of the crest. A large portion of this concrete has deteriorated and washed away in the last few years, leaving only a portion of the slab at the spillway crest. The remaining concrete is severely undermined at its downstream end (see Photo 13). The spillway discharge channel has experienced considerable erosion immediately downstream of the crest (see Photos 14 and 15). The spillway discharge channel is fairly clear for about 100 ft before entering a wooded area. It empties into the old streambed below the small pond beyond the toe of the dam.

C.2 Emergency Spillway:

There is no emergency spillway associated with this dam.

D. Reservoir:

The watershed is generally wooded with little or no agricultural activity. The slopes adjacent to the reservoir are moderate, and no sloughing or serious erosion was noted. The water in the reservoir was clear, and no evidence of excessive sedimentation was noted.

E. Downstream Channel:

The downstream channel is overgrown with trees and brush downstream of the small pond. The channel goes under a roadway about 500 ft downstream of the dam and meets another small creek from the northwest. The creek then runs along the west side of the road (Highway V) to its confluence with Diles Creek about 0.6 miles from the dam. Diles Creek then runs back under Highway V in a southeasterly direction.

3.2 EVALUATION:

The dam is in fair condition. The tree and brush growth on the embankment can provide shelter for small animals and encourage burrowing. The wave erosion, sloughing, and animal burrows on the upstream embankment face could worsen and adversely affect embankment stability. The seepage along the embankment toe could also seriously affect the stability of the dam. The undermining of the spillway and the deterioration of the discharge channel will worsen if not corrected, and the capability of the dam to store water will be jeopardized.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no operating facilities associated with this dam. The pool is normally controlled by rainfall, runoff, evaporation, the capacity of the uncontrolled spillway, and seepage from the reservoir.

4.2 MAINTENANCE OF DAM:

The presence of brush and tree growth, erosion, sloughing, and animal holes indicates that the dam has not been adequately maintained recently.

4.3 MAINTENANCE OF OPERATING FACILITIES:

There are no operating facilities for this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

The undermining of the concrete spillway slab, debris in the spillway approach channel, brush and tree growth on the embankment, seepage from the dam and along the embankment toe, deterioration of the spillway discharge channel, and wave erosion, sloughing, and animal holes on the upstream face are serious deficiencies which should be corrected. However, to avoid creating an unsafe condition, these deficiencies should only be corrected under the direction of an engineer experienced in the design and construction of dams.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

No hydrologic or hydraulic design computations for this dam were available.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for this lake and watershed. The owner reported that the dam has never overtopped. The spillway operates several times a year, and the highest water behind the dam was about 1 ft below the embankment crest.

C. Visual Observations:

No evidence of overtopping of the embankment was observed. The approach area to the spillways was filled with silt and wood debris. The concrete slab which protects the spillway section is severely undermined at its downstream end. The outlet channel has experienced significant erosion.

D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U.S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on: (1) a field survey of spillway dimensions and embankment elevations; and (2) an estimate of the reservoir storage and the pool and drainage areas from the Couch, Missouri, 15 Minute USGS quad sheet. It was assumed in the analysis that the debris in the spillway approach channel will be washed away by early spillway releases. Therefore, a spillway elevation of 772.0 was used in the analysis.

Based on the hydrologic and hydraulic analysis presented in Appendix C, the spillway will pass 17 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the small height of the dam and the low storage capacity of the reservoir, 50 percent of the PMF has been

determined to be the appropriate spillway design flood. The spillway will pass the 1 percent probability flood without overtopping the dam.

Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 3,347 cfs. For 50 percent of the PMP, the peak inflow was 1,674 cfs.

The routing of the PMF through the spillway and dam indicates that the dam will be overtopped by 2.2 ft at elevation 777.0. The duration of the overtopping will be 6.0 hours, and the maximum outflow will be 3,116 cfs. The maximum discharge capacity of the spillway is 300 cfs. The routing of 50 percent of the PMF indicates that the dam will be overtopped by 1.3 ft at elevation 776.1. The maximum outflow will be 1,353 cfs, and the duration of overtopping will be 2.4 hours. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

No design and construction data were available for this dam. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

There were no reported post-construction changes made to this dam.

E. Seismic Stability:

The structure is located between seismic zones 1 and 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for these zones be applied in stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in fair condition. Several items were noted during the visual inspection which should be investigated further, corrected, or controlled. These items are: (1) severe undermining of the concrete spillway slab; (2) some erosion of the spillway discharge channel; (3) erosion and sloughing of the upstream embankment face due to lack of wave protection; (4) some brush, small trees, and animal burrows on the upstream embankment face; (5) considerable brush and some small trees on the downstream face of the dam; (6) seepage area along lower portion of the downstream face near the toe; and (7) considerable soil and wood debris in the spillway approach channel.

Another deficiency was the lack of seepage and stability analysis records.

The dam will be overtopped by flows in excess of 17 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by the owner, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished promptly. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will continue to deteriorate and possibly could become serious in the future. The item recommended in paragraph 7.2A should be pursued promptly.

D. Necessity for Additional Inspection:

Based on the result of the Phase I inspection, no additional inspection is recommended.

E. Seismic Stability:

The structure is located between seismic zones 1 and 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for these zones be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Alternatives:

(1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

B. O&M Procedures:

(1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.

(2) The spillway crest area should be provided with a permanent control section, which is protected against undermining. The downstream channel beyond the control section should be protected against erosion.

(3) The erosion, sloughing, and animal holes on the upstream embankment face should be repaired, and wave protection should be provided.

(4) Trees and brush should be removed from the face of the dam on an annual basis. The initial clearing should be done under the guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.

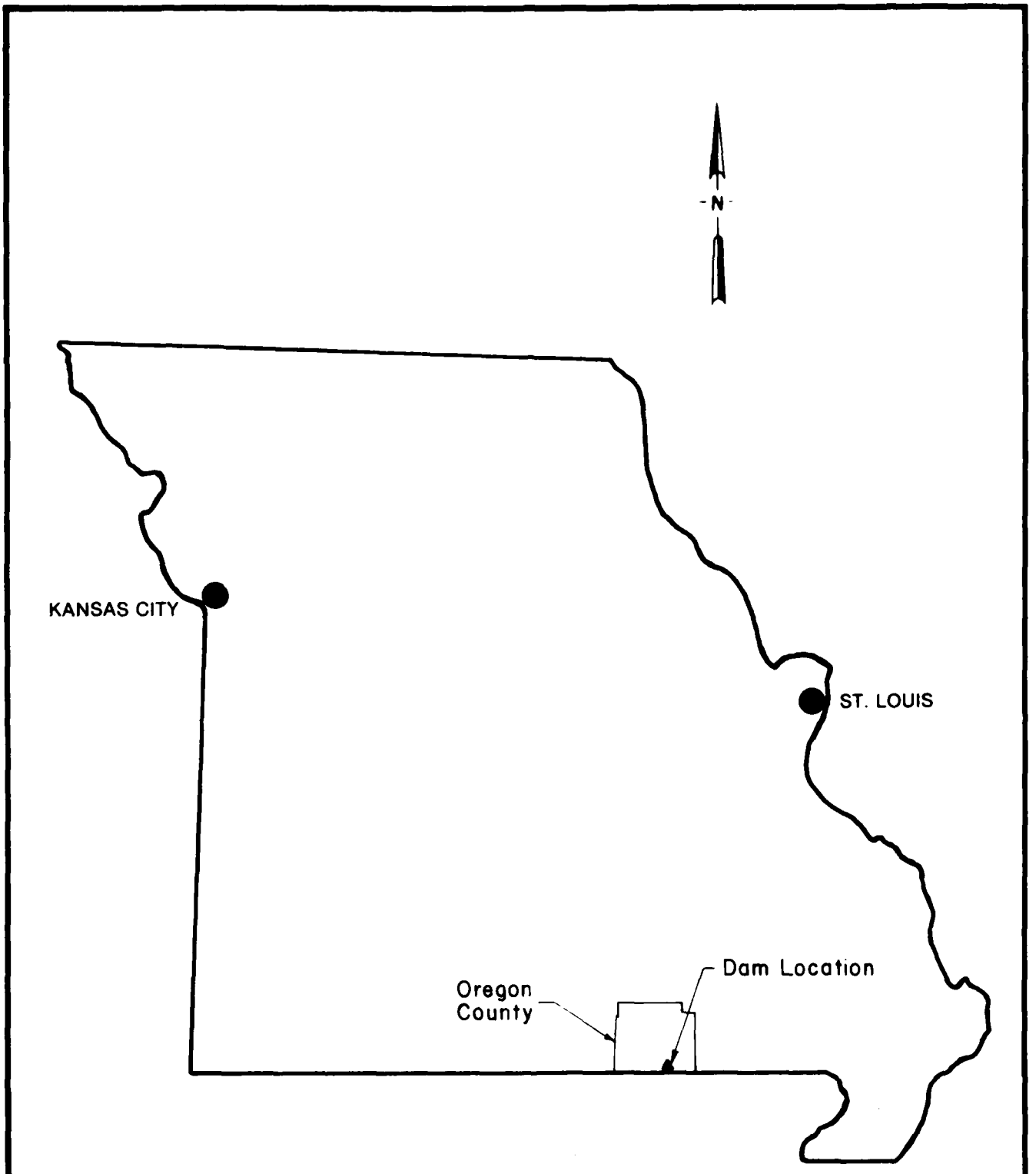
(5) The seepage area along the downstream embankment toe should be investigated by an engineer experienced in the design and construction of dams. Remedial measures may be required. As a minimum, these areas should be inspected periodically in an effort to detect an increase in the quantity of seepage or any indication that soil particles are being carried by the water. In this event, an experienced engineer should be contacted immediately.

(6) The soil and wood debris in the spillway approach channel should be cleared.

(7) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Dam Location and Plans



LOCATION MAP

HANSON ENGINEERS INCORPORATED

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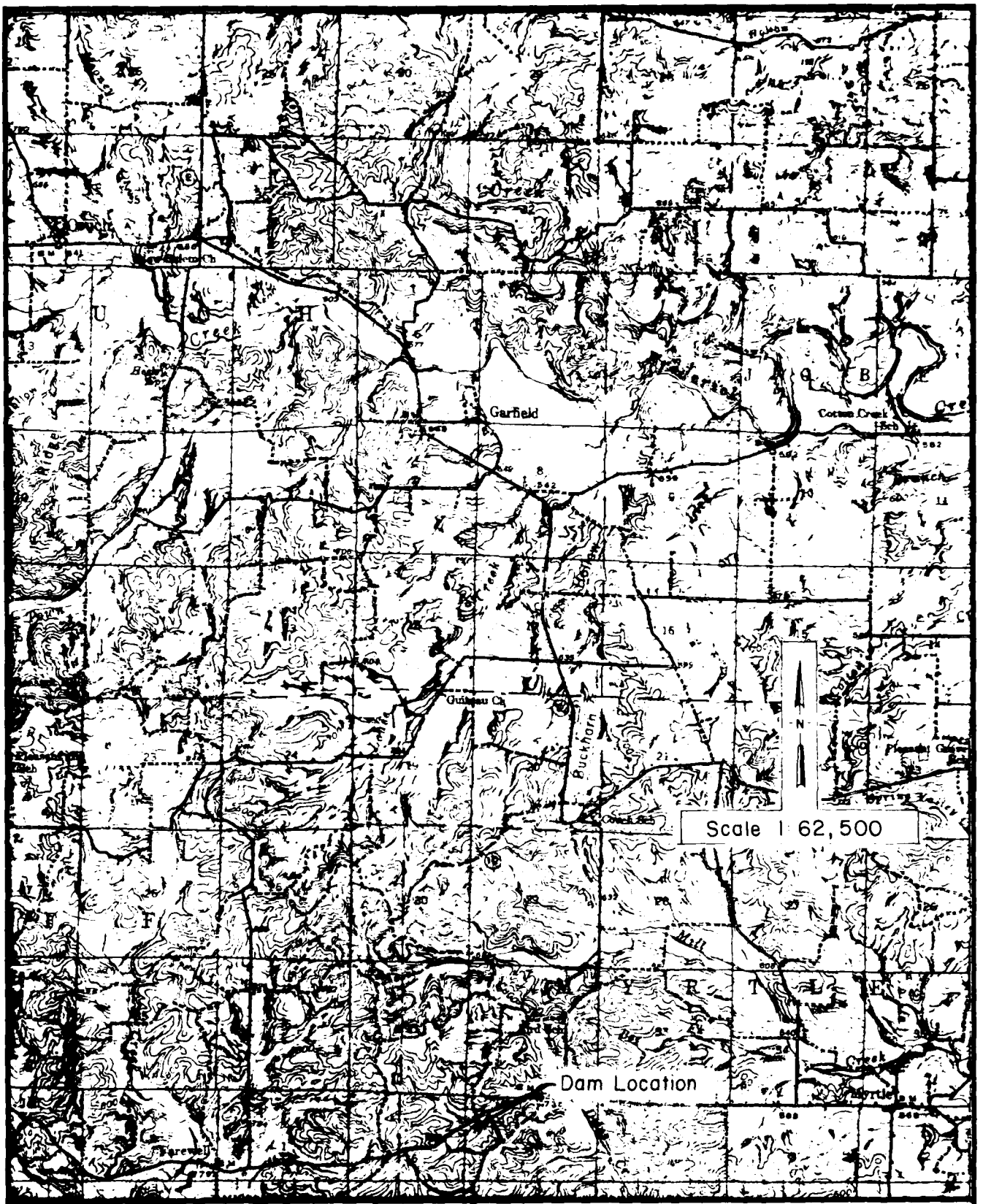
S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

SHEET 1, APPENDIX A



VICINITY MAP

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INCORPORATED

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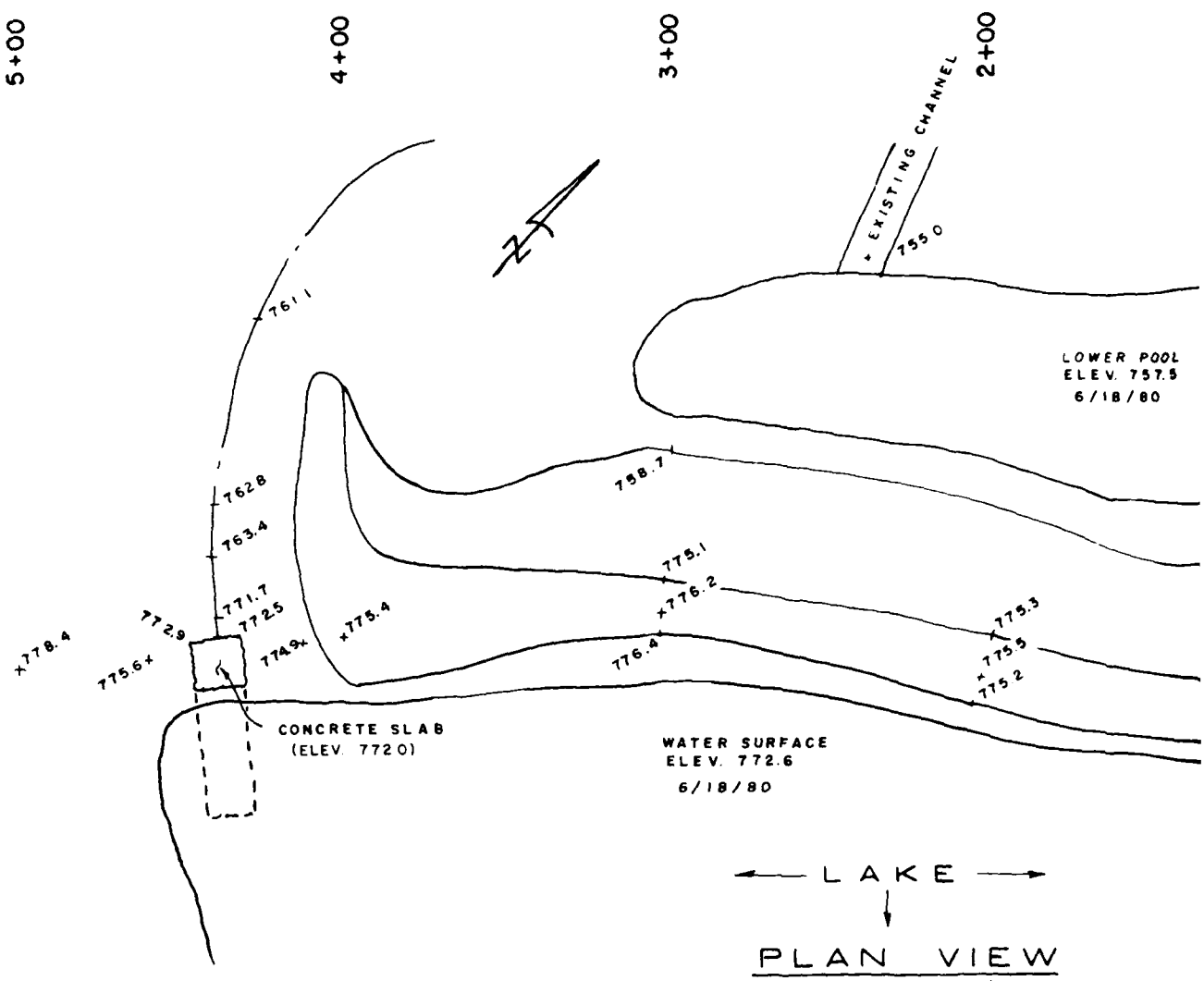
S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

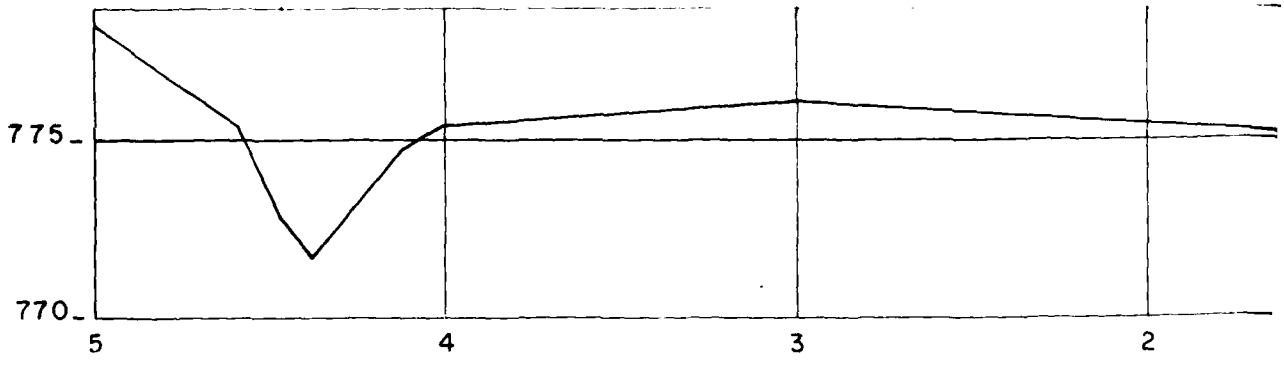
Sheet 2, Appendix A



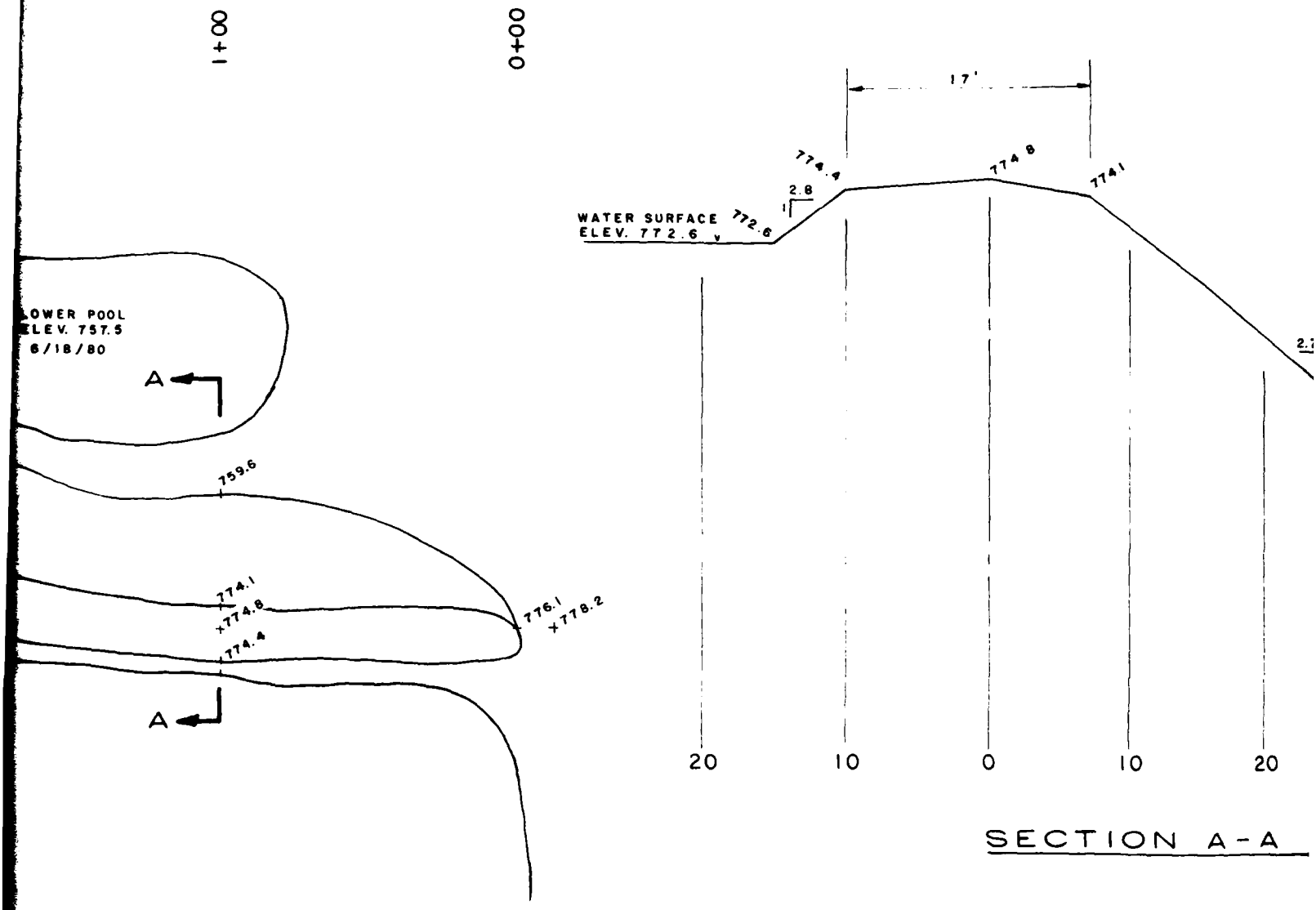
PLAN VIEW

SCALE: 1" = 50'

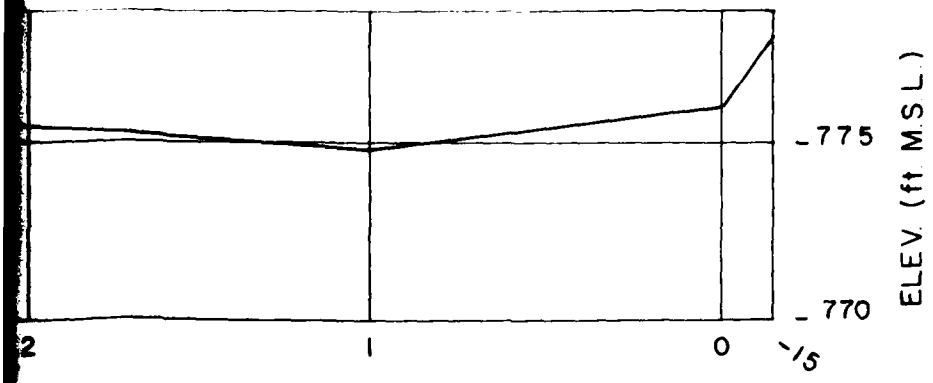
BENCHMARK:
SOUTHEAST WINGWALL OF 3' x 8' CULVERT
ON HIGHWAY 'V' APPROX. 500 FEET NORTHEAST
OF DAM ELEV. 755.0

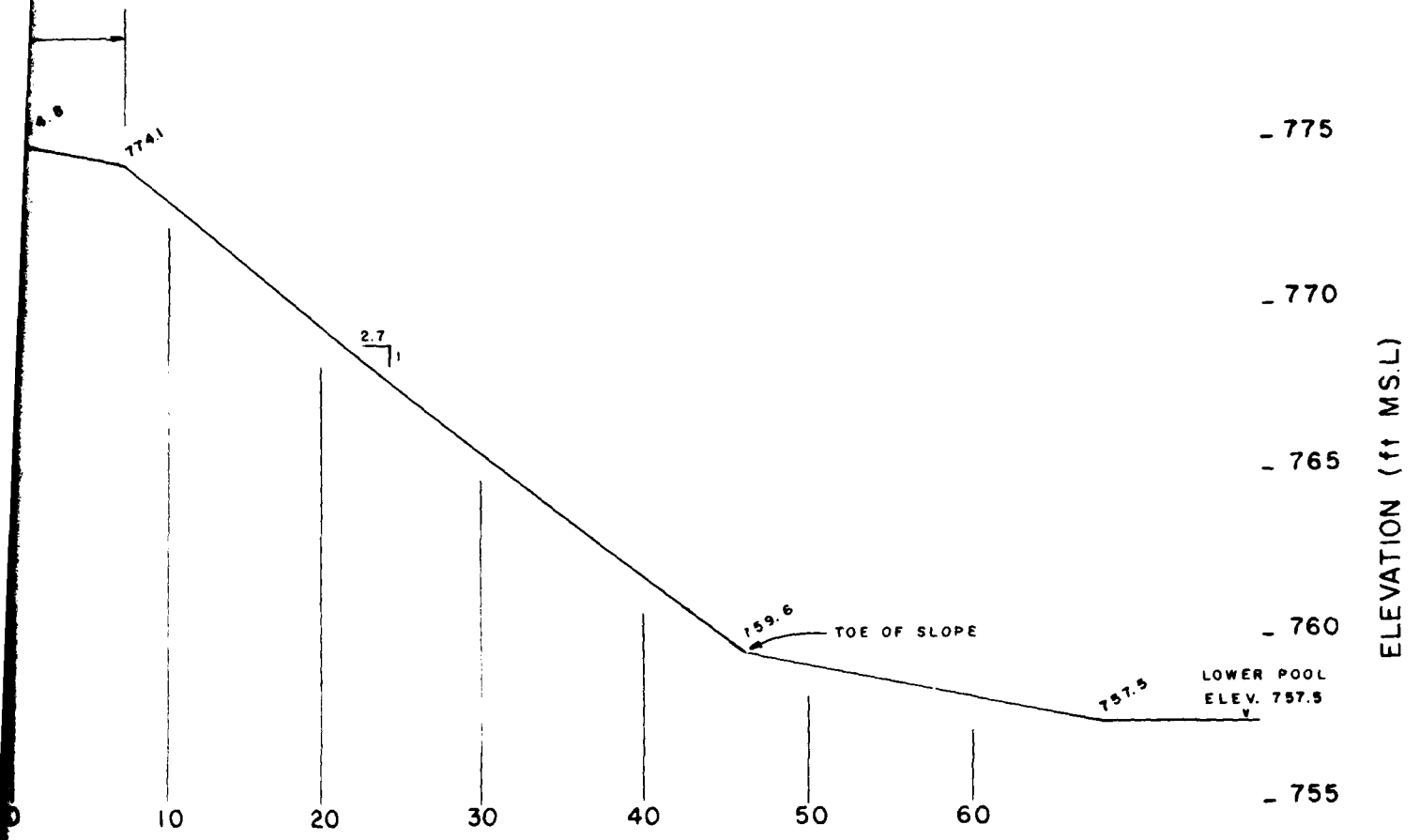


PROFILE


1+00
0+00
17'
774.9
774.8
774.1
2.8
1
WATER SURFACE
ELEV. 772.6
772.6
LOWER POOL
ELEV. 757.5
6/18/80
A
759.6
774.1
+774.8
774.4
776.1
+778.2
A
20
10
0
10
20

SECTION A-A


775
770
ELEV. (ft MSL)
2
1
0
1/s



SECTION A-A STA 1+00

SHEET 3 APPENDIX A

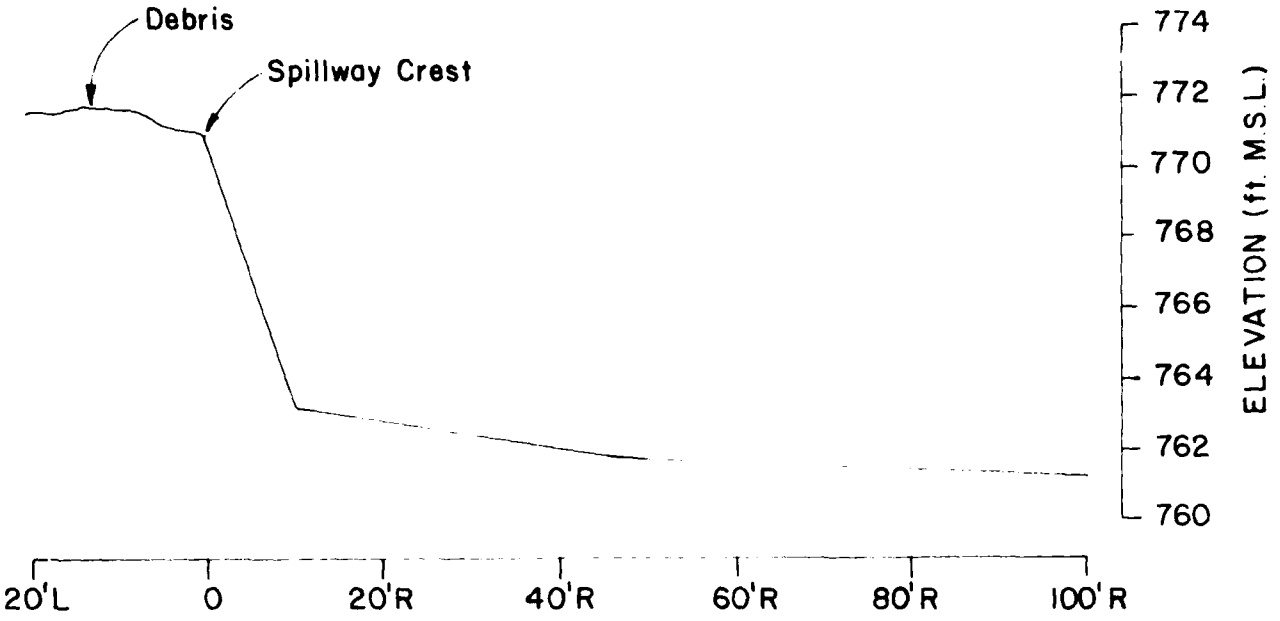
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

JONES LAKE DAM

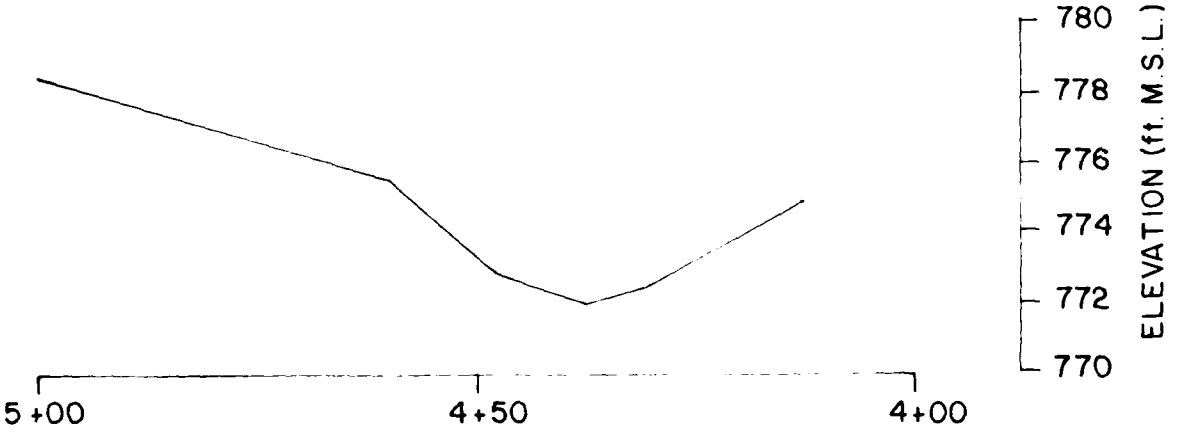
MO. No. 31486

PLAN & PROFILE

OREGON COUNTY, MO.



SPILLWAY PROFILE (Sta. 4+38)



SPILLWAY CROSS-SECTION

PROFILE & SECTION OF SPILLWAY

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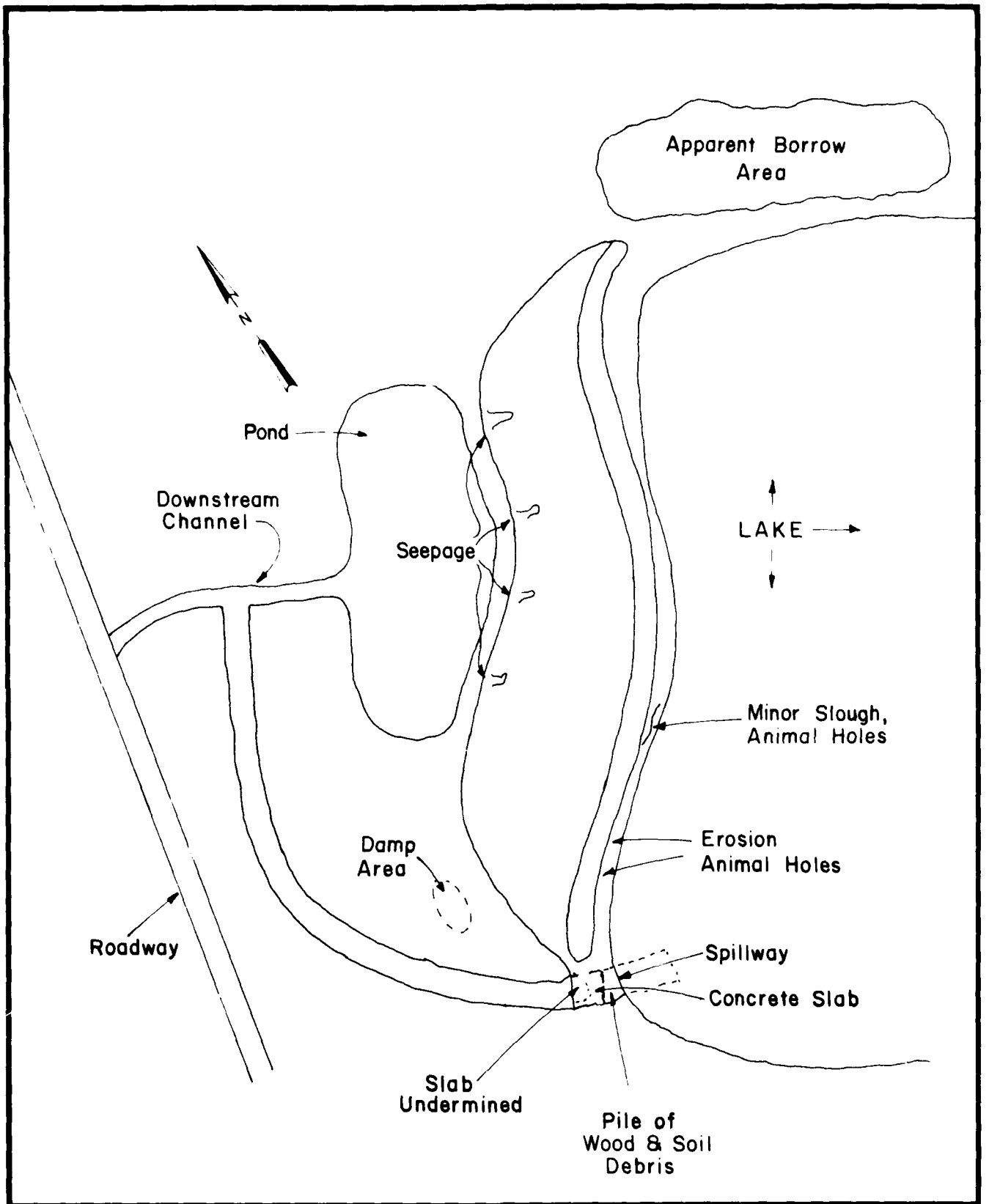
S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

Sheet 4, Appendix A



PLAN FEATURES OF DAM

HANSON ENGINEERS INCORPORATED

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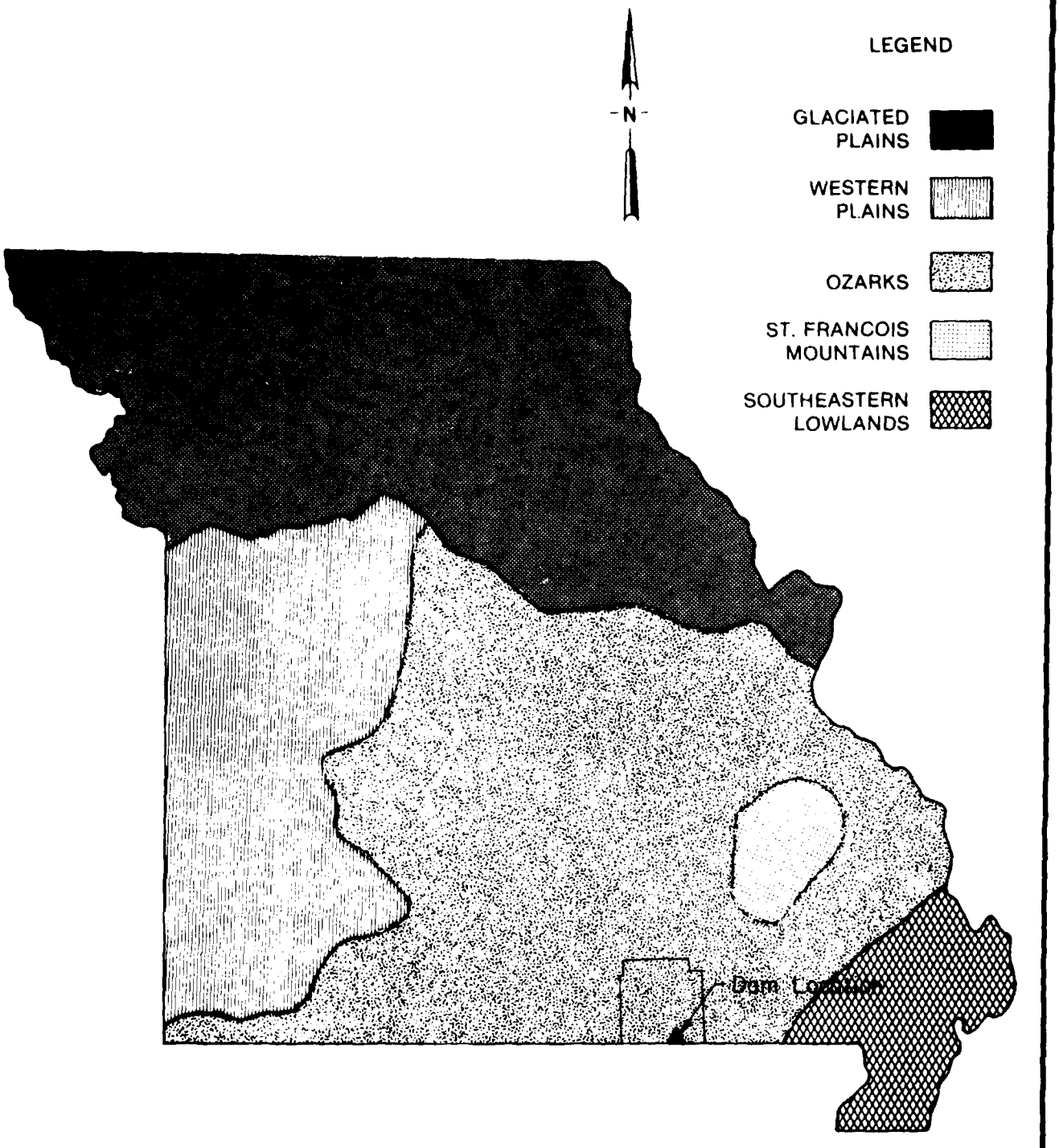
S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

Sheet 5, Appendix A

APPENDIX B

Geology and Soils



MAJOR GEOLOGIC REGIONS OF MISSOURI

HANSON ENGINEERS

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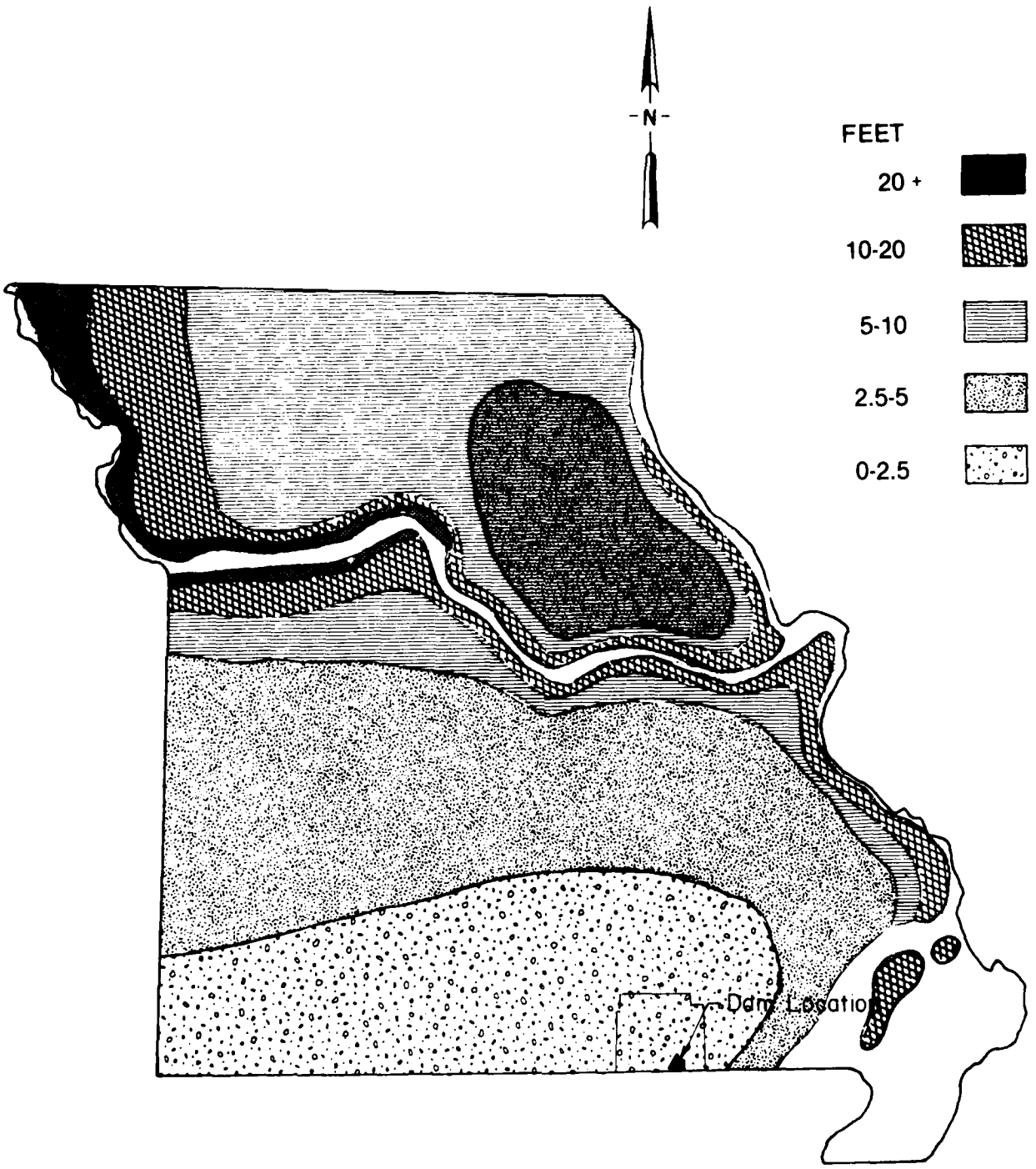
S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

SHEET 1, APPENDIX B



THICKNESS OF LOESSIAL DEPOSITS

HANSON ENGINEERS

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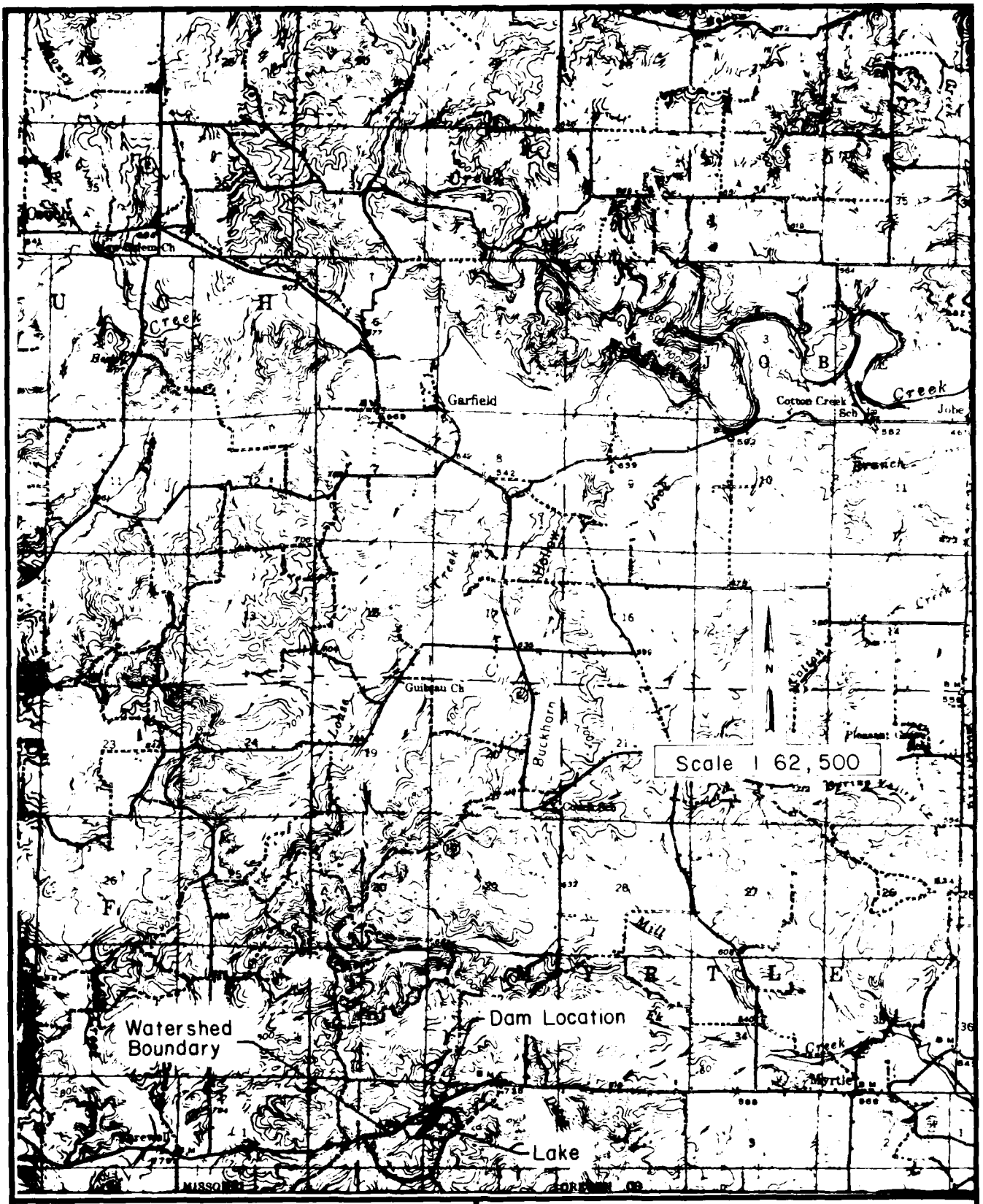
S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

SHEET 2, APPENDIX B

APPENDIX C

Overtopping Analysis



LAKE AND WATERSHED MAP

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S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

Sheet 1, Appendix C

APPENDIX C

HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination). Also, the 1 percent chance probability flood was routed through the reservoir and spillway. Doniphan rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corps of Engineers, was used in this case.

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The time of concentration was estimated using the Kirpich formula. This formula and the parameters for the unit hydrograph are shown in Table 1 (Sheet 3, Appendix C).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the results from the computer output, are shown in Table 2 (Sheet 4, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method assuming the starting lake elevation at normal pool. No antecedent storm was considered in this case. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area--storage-discharge relationships shown in Table 3 (Sheet 4, Appendix C).

The rating curve for the spillway (see Table 4 Sheet 5. Appendix C) was determined assuming critical flow condition at the control section.

The flow over the crest of the dam during overtopping was determined using the non-level dam option ($L and $V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. The lowest elevation of the crest of the dam found during the survey was assumed as top of dam elevation (780.0).

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 6, Appendix C).

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 7, 8 and 9 of Appendix C.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.234 sq. miles
Length of Watercourse (L)	0.63 miles
Difference in elevation (H)	128 feet
Time of concentration (Tc)	0.24 hours
Lag Time (Lg)	0.14 hours
Time to peak (Tp)	0.18 hours
Peak Discharge (Qp)	630 cfs
Duration (D)	5 min.

Time (Min.)(*)	Discharge (cfs)(*)
0	0
5	252
10	620
15	499
20	231
25	112
30	53
35	25
40	12
45	6
50	3

(*) From the computer output

FORMULA USED:

$Tc = \left(\frac{11.9\ L^3}{H} \right)^{0.385}$ Kirpich Formula. From California Culverts Practice, California Highways and Public Works, September, 1942.

$Lg = 0.6\ Tc$

$Tp = \frac{D}{2} + Lg$

$Qp = \frac{484\ A.Q}{Tp}$ Q = Excess Runoff = 1 inch

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMP	24	36.4	33.4	3.0
1% Prob. Flood	24	7.55	2.23	4.32

Additional Data:

1) Soil Conservation Service Soil Group B
2) Soil Conservation Service Runoff Curve CN = 78 (AMC III) for the PMF
3) Soil Conservation Service Runoff Curve CN = 60 (AMC II) for the 1 percent probability flood
4) Percentage of Drainage Basin Impervious 5 percent

TABLE 3

ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
755.0	0	0	-
760.0	2	5	-
772.0	5	47	0
*774.8	8	65	300
**780.0	13	120	-

*Primary spillway crest elevation
**Top of dam elevation

The above relationships were developed from the COUCH, MO 15 minute quadrangle map and the field measurements.

TABLE 4

SPILLWAYS RATING CURVE

Reservoir Elevation (MSL)	Primary Spillway (cfs)
772.0	0
773.0	30
773.5	80
774.0	150
*774.8	300
775.0	350
775.5	480
776.0	640
776.5	840
777.0	1060
777.6	1500

*Top of dam elevation

METHOD USED: Assuming critical flow at the control section.

FORMULA:

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

Q = Discharge in cubic feet per second

A = Cross sectional area in square feet

T = Water surface width in feet

g = acceleration of gravity in ft/sec^2

TABLE 5

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam
-	0	*772.0	47	0	-
0.10	335	774.1	60	159	-
0.15	502	774.6	64	266	-
0.17	569	**774.8	65	300	0
0.20	669	775.0	67	360	0.2
0.25	837	775.3	70	476	0.5
0.30	1004	775.6	73	632	0.8
0.40	1339	775.9	77	989	1.1
0.50	1674	776.1	79	1353	1.3
0.75	2510	776.6	84	2286	1.8
1.00	3347	777.0	88	3116	2.2

The percentage of the PMF that will reach the top of the dam is 17 percent.

*Primary spillway crest elevation
**Top of dam elevation

```
A       OVERTOPPING ANALYSIS FOR JONES LAKE DAM ( # 13 )
A       STATE ID NO. 31486  COUNTY NAME : OREGON
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 80S3001
B    300              5
B1     5
J      1       9       1
J1   .10     .15     .20     .25     .30     .40     .50     .75     1.0
K      0       1                               3       1
K1       INFLOW HYDROGRAPH COMPUTATION **
M      1       2    .234            .234       1                       1
P      0    28.0     102     120     130
T                                                   -1      -78             0.05
W2  0.24    0.14
X      0      -.1       2
K      1       2                       0       4       1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE **
Y                                       1       1
Y1     1                                                47      -1
Y4   772     773   773.5     774   774.8     775   775.5     776   776.5     777
Y4 777.6
Y5     0      30      80     150     300     350     480     640     840    1060
Y5  1500
$S     0       5      47      65     120
$E   755     760     772   774.8     780
$$   772
$D 774.8
$L     0     140     200     340     400     410
$V 774.8   775.4   775.5   776.1   776.4   778.2
K     99
```

PMF RATIOS
INPUT DATA

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.75	1.00
HYDROGRAPH AT	1	0.23	1	335.	502.	669.	837.	1004.	1339.	1674.	2510.	3347.
	(	0.61)	(	9.48)(	14.22)(	18.96)(	23.70)(	28.43)(	37.91)(	47.39)(	71.09)(	94.78)
ROUTED TO	2	0.23	1	159.	266.	360.	476.	632.	989.	1353.	2286.	3116.
	(	0.61)	(	4.51)(	7.53)(	10.19)(	13.49)(	17.90)(	28.00)(	38.31)(	64.74)(	88.24)

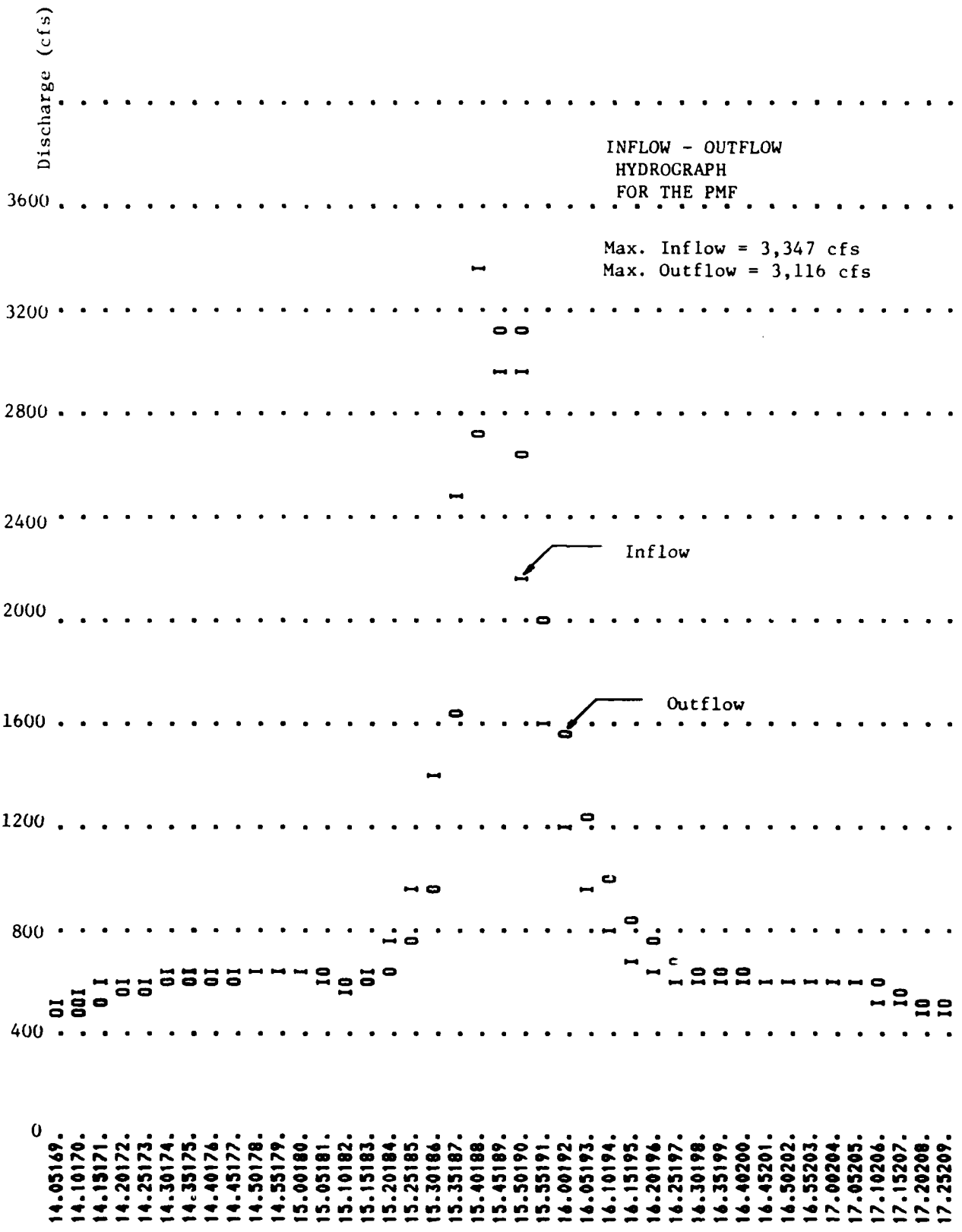
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	772.00	772.00	774.80
STORAGE	47.	47.	65.
OUTFLOW	0.	0.	300.

PMF RATIOS
OUTPUT DATA

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	774.05	0.00	60.	159.	0.00	15.92	0.00
0.15	774.62	0.00	64.	266.	0.00	15.92	0.00
0.20	775.02	0.22	67.	360.	0.50	15.92	0.00
0.25	775.30	0.50	70.	476.	0.75	15.83	0.00
0.30	775.55	0.75	73.	632.	0.83	15.83	0.00
0.40	775.89	1.09	77.	989.	1.33	15.83	0.00
0.50	776.14	1.34	79.	1353.	2.42	15.75	0.00
0.75	776.61	1.81	84.	2286.	5.08	15.75	0.00
1.00	776.95	2.15	88.	3116.	6.00	15.75	0.00



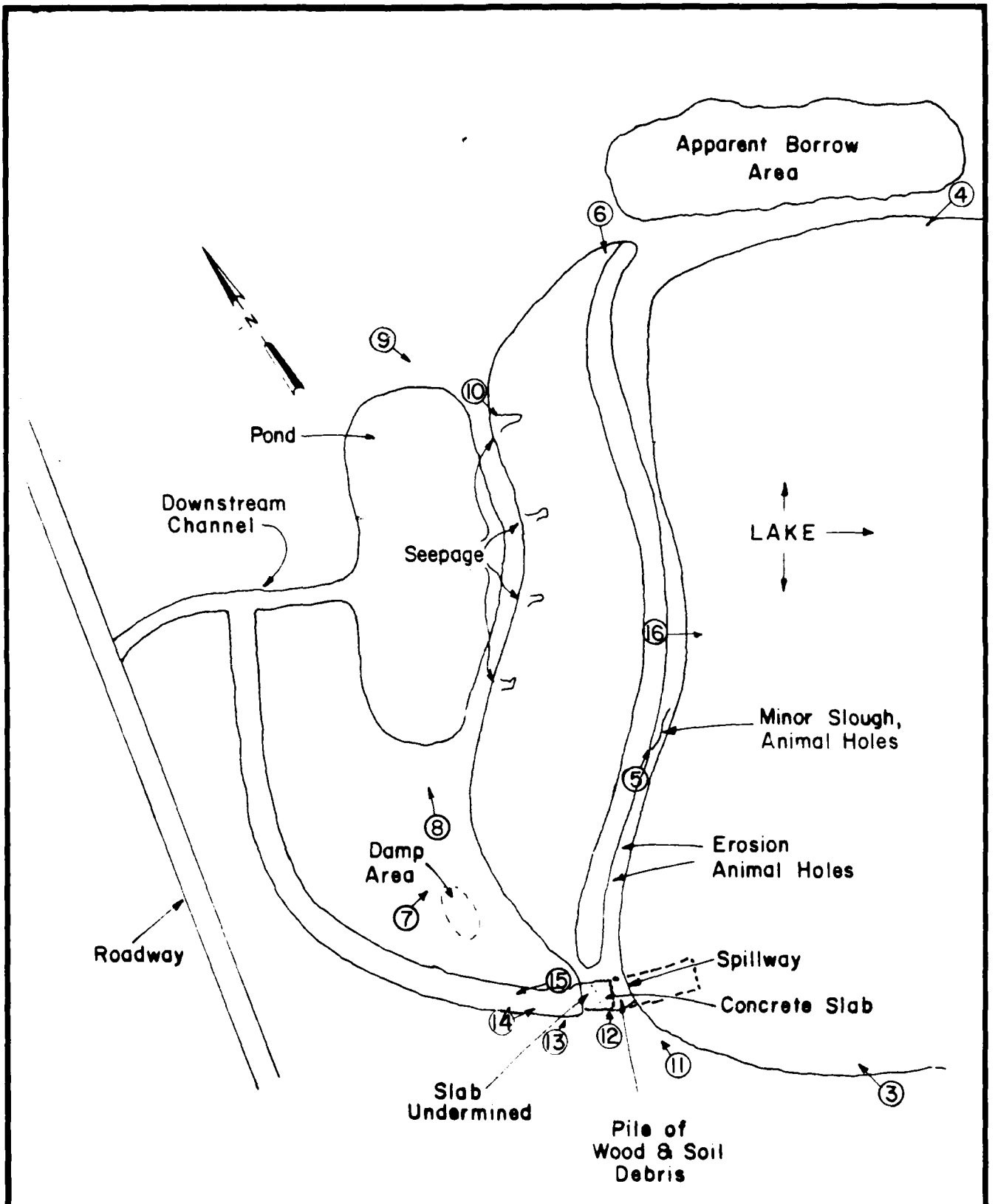
Sheet 9, Appendix C

APPENDIX D

Photographs

INDEX TO PHOTOGRAPHS

Photo No.	Description
1.	Aerial view of dam and lake, looking north.
2.	Aerial view of dam and lake, looking southeast.
3.	Upstream face of dam from left abutment area, looking north.
4.	Upstream face of dam from right abutment area, looking west.
5.	Animal holes and tunnels, upstream face.
6.	Crest of dam from right abutment, looking south.
7.	Downstream face of dam from left abutment, looking northeast.
8.	Pond at downstream toe from left abutment, looking northeast.
9.	Downstream face of dam from right abutment area, looking south.
10.	Seepage area on downstream face.
11.	Approach area of spillway -note pile of debris.
12.	Spillway area, looking north-note pile of debris on right and undermined on left.
13.	Spillway slab -note undermining.
14.	Spillway outlet channel, looking upstream.
15.	Spillway outlet channel, looking downstream.
16.	View of lake from crest of dam.



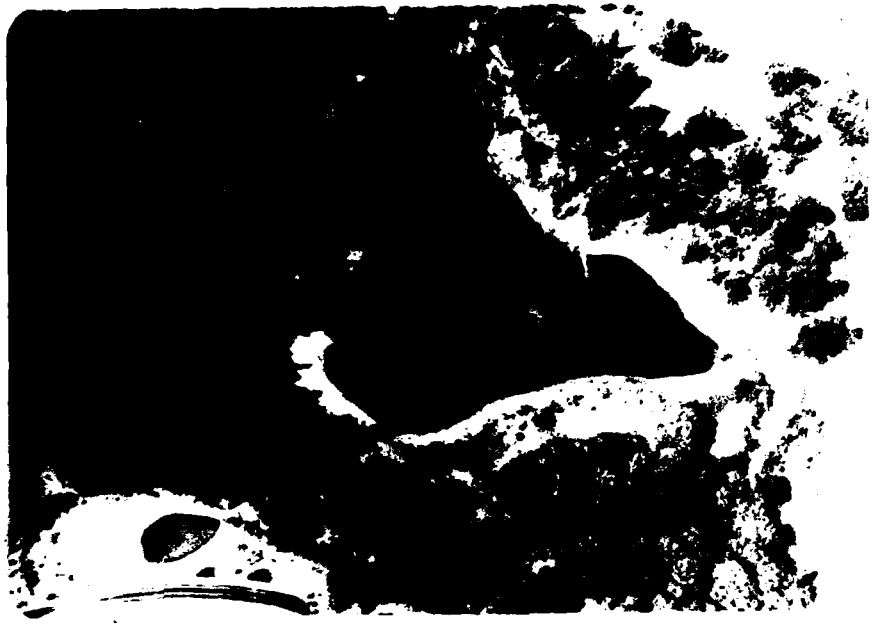
PHOTOGRAPH LOCATIONS

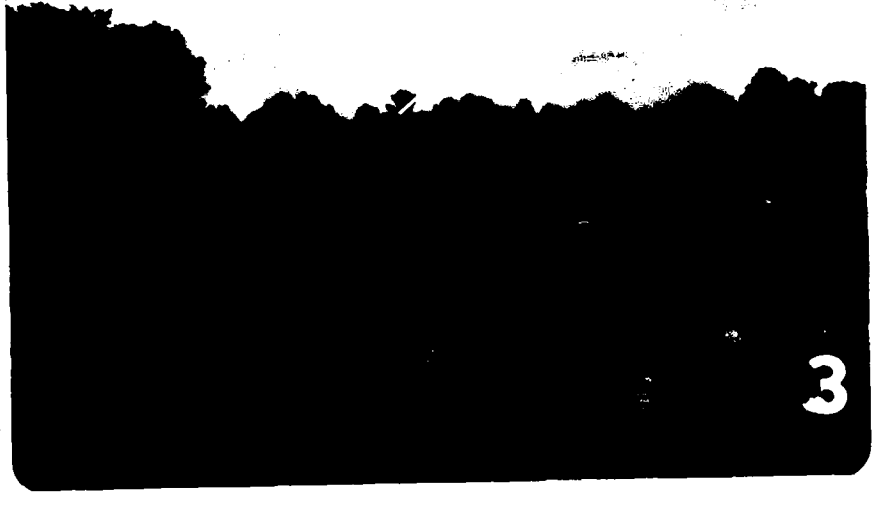
HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

S. Jones Lake Dam
Oregon County, Missouri
Mo. I.D. No. 31486

Sheet 2, Appendix D

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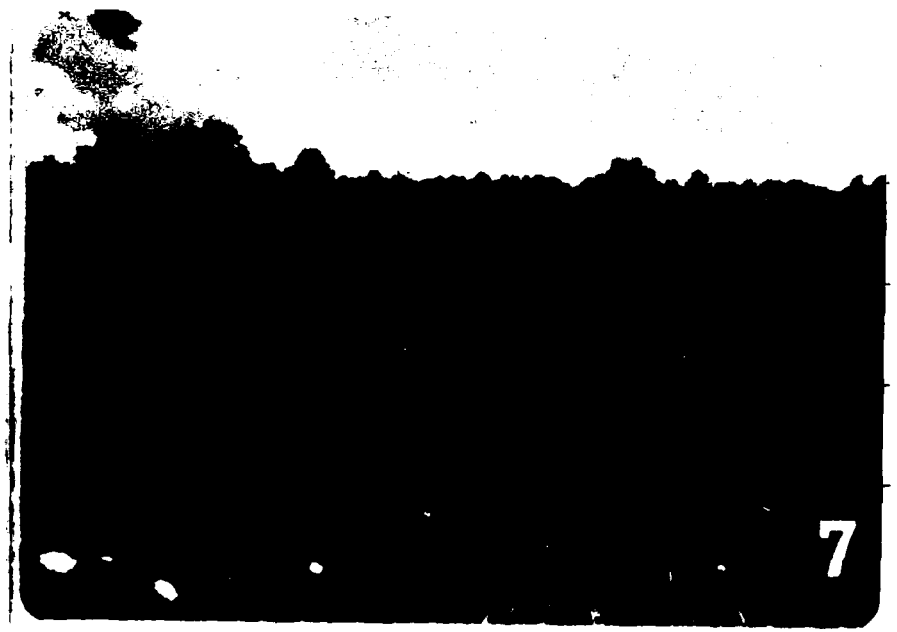
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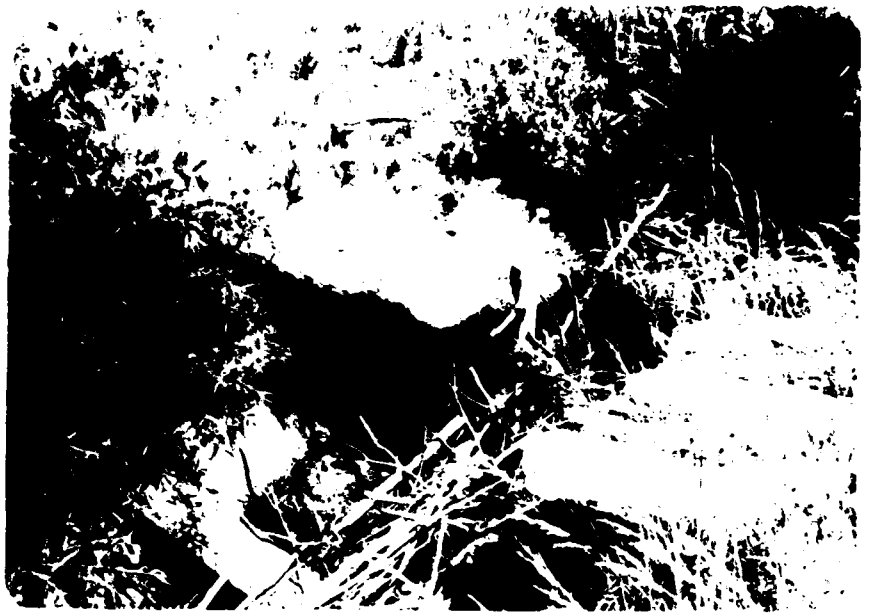
11



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